

REMARKS

Claims 1-31, as amended, as well as new claims 32-35, are currently pending for the Examiner's review and consideration. Applicants appreciate Examiner's acknowledgment of the persuasiveness of Applicants' request for reconsideration and Examiner's withdrawal of the obviousness rejections, and particularly the finality of the rejections, presented in the previous Final Office Action.

Claims 1, 4, 24, and 29 have all been amended to recite trialkylammonium or tetraalkylammonium compounds instead of quaternary ammonium compounds. Exemplary support for this amendment can be found in the originally-filed specification, *e.g.*, at ¶[0056] on page 8. Claims 1 and 24 have also been amended to recite a specific pH range from about 1.5 to about 6, as supported in the originally-filed specification, *e.g.*, at ¶[0080] on page 13. In addition, claim 1 has been amended to more clearly recite the Markush group of alkaline components, the optional compounds, and the claimed invention. Further, claim 29 has been amended to recite that the dilute aqueous cleaner is a semiconductor cleaner. Exemplary support for this amendment can be found in the originally-filed specification, *e.g.*, in originally-filed claim 1 and ¶[0081], *inter alia*. Claim 25 was amended to recite that the formulation is substantially free from surfactants. Exemplary support for this amendment can be found in the originally-filed specification, *e.g.*, at ¶[0078] on page 13. New independent claims 32 and 34 recites a dilute aqueous cleaner/residue remover consisting essentially of phosphoric acid, glycolic acid, and water. Support for these new claims can be found in the originally-filed specification, *e.g.*, at ¶[0038] on page 5. Additional support for new claim 34 can be found in the originally-filed specification, *e.g.*, at Examples 14, 25, and 26 in the Table on page 17. New dependent claims 33 and 35 depend from claims 32 and 34, respectively, and recite a list of components that the solutions are substantially free from. Exemplary support for this new claim can be found in the originally-filed specification, *e.g.*, at ¶¶[0063], [0067]-[0068], [0073]-[0074], [0076], and [0078].

As no new matter has been added by these amendments, new claims, or remarks, Applicants respectfully request their entry into the record at this time and their consideration regarding the above-captioned application.

THE REJECTIONS UNDER 35 U.S.C. § 103(a) SHOULD BE RECONSIDERED AND WITHDRAWN

1. Rejections Over Leon And Gogg.

Claims 1-13, and 17-28 stand rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 6,030,932 to Leon *et al.* (“Leon”), in view of U.S. Patent No. 6,686,297 to Gogg *et al.* (“Gogg”), for the following reasons. The Examiner states that Leon discloses a cleaning composition which comprises water, a hydroxylamine or quaternary ammonium compound, and a fluorine-containing compound. Further, Leon teaches that the pH of the composition should be between 2-9. The Examiner then acknowledges that Leon does not teach phosphoric acid. The Examiner uses Gogg, who describes a cleaning composition, and who teaches that phosphoric acid can be added as an additive for adjusting the pH to a desired level, thereby increasing the effectiveness of the cleaning composition. Applicants respectfully traverse.

No Motivation To Combine The References

First, there is no motivation to combine the references. Leon discloses a cleaning composition comprising water, a fluorine-containing compound, and either (a) a compound selected from an amine, a quaternary ammonium compound, and ammonium hydroxide, or (b) hydroxylamine or a salt thereof. *See* Leon Abstract. Leon indeed teaches that a pH of 2-9 is desired such to minimize attack on metal layers. The Examiner is using Gogg to provide a pH adjusting compound, namely phosphoric acid. However, Leon does not suggest using any pH adjusting compounds. Instead, Leon at column 5, lines 13-21, expressly teaches:

the components in the cleaning composition should be admixed in appropriate concentrations to provide a composition having a pH with a preferred range from about 2 to 9, and more preferably from about 2 to 6.

See also Leon at column 6, lines 30-35. Leon teaches a composition with a balanced amount of the acidic fluorine-containing compounds and the alkaline amine or hydroxylamine compounds. Selected organic acids are taught by Leon to be corrosion inhibitors, in particular lactic acid, gallic acid, and gallic acid esters, which can be admixed into the composition of Leon. The Examiner opines that rather than using such compounds, which are taught by Leon to have other primary uses, that one of ordinary skill in the art would look elsewhere for a mineral acid. By turning to Gogg, the Examiner is disregarding the teaching of Leon, implying that any

concentration of an acidic fluoride and an amine are taught, as you can always add any pH adjustors. Applicants maintain this is contrary to the teaching of Leon.

Leon does contemplate the use of his invention in combination with ozonated water which is used to strip off photoresists and other residues. Leon suggests using a combination of deionized water and ozone, which are contacted by submerging the substrates into the ozonated water or by using a spray rinse. *See Leon at column 6, lines 49-63.* By "in combination with," Leon clearly teaches sequential operations, one with ozonated water and one with his cleaner. There is no teaching or suggestion to add ozonated water to his composition, and there is no teaching or suggestion that both ozonated water and Leon's cleaners contact a substrate simultaneously.

Gogg also does not provide any motivation to be combined with Leon. Gogg addresses the problem of contacting a substrate with a water at elevated temperature and beneficially having a high concentration of ammonium hydroxide and optionally other additives which are not repugnant to ozone, while also providing a high concentration of ozone. *See Gogg at column 1, lines 38-46, and at column 2, lines 16-18.* Additives are added to target certain contaminants and "to enhance the effectiveness of the cleaning." *See Gogg at column 1, lines 23-31, and at column 3, lines 51-53.* Gogg suggests as additives 1) an acid, giving examples which are HF or phosphoric acid, 2) a base, of which the only example given is ammonium hydroxide, or 3) a mixture of an acid and a base. *See Gogg at column 1, lines 23-31, and at column 3, lines 51-57.* Gogg does not teach compositions having both HF and phosphoric acid. Gogg does not recommend phosphoric acid for cleaning purposes, that is, for removal of contaminants, organics, and particles. Gogg recommends as additives ammonium hydroxide "for particle and organic removal," and with respect to acids Leon states "other additives that enhance the cleaning capability of the treatment include hydrofluoric acid (HF) and hydrochloric acid (HCl). Such additives have the following benefits/effects: 1) removal of organic contaminants; 2) removal of oxide and regeneration of a controlled chemical oxide; 3) removal of particles; 4) removal of metals." *See Gogg at column 3, lines 23-31, and at column 3, lines 51-57.* Gogg does recommend phosphoric acid or a buffer of phosphoric acid and ammonia, which are advantageously included as an ozone stabilizer. *See Gogg, column 5, lines 15-27.*

The Examiner combines selected portions of Leon with selected portions of Gogg in a classic hindsight reconstruction of the invention. Leon teaches an aqueous composition with a

balanced amount of acidic fluorine-containing compounds and alkaline amine or hydroxylamine compounds, where the proportions of the compounds are such that the pH is 2-9. The composition of Leon contains no ozone – if ozonated water is used, it is a deionized ozonated water rinse. Gogg teaches HF or phosphoric acid in ozonated water, where HF is useful to enhance cleaning, and phosphoric acid is useful as a pH adjustor that is a particularly good ozone stabilizer. The composition of Gogg has neither hydroxylamines nor amines. The only ingredients Leon and Gogg have in common in their primary solutions are are water and acidic fluorides. The Examiner's reconstruction ignores Leon's teaching of balanced proportions of hydroxylamines/amines and acidic fluorides, suggesting one of skill in the art would merely add a pH adjustor. The Examiner, when faced with Gogg's teaching to use acidic fluorides to provide added cleaning power or phosphoric acid to stabilize ozone, suggests that one of skill in the art would choose the phosphoric acid (the ozone stabilizer) over the acidic fluoride (which is a cleaner enhancer, as is also taught by Leon) to adjust the pH of the composition after ignoring Leon's instructions to formulate a pH balanced composition of the acidic fluoride and the amines, even though the composition of Leon has no ozone. It is Applicants position that the Examiner has not provided sufficient motivation for the combination of the references, and has shown no motivation for the specific components combined.

Applicants therefore respectfully request reconsideration of the rejections over the combination of Leon and Gogg.

In the interests of resolving all issues, we note that while Leon does not disclose the presence of phosphoric acid in this cleaning composition, Leon teaches that hydroxylamine can be reacted with an acid ("e.g., nitric acid or sulfuric acid;" *see* Leon, column 4, line 40) to form a hydroxylamine salt, which can then be added to the composition. Leon also teaches that hydroxylammonium phosphate is a potentially useful hydroxylamine salt. *See Id.*, column 4, line 45. Such an acid salt is indeed acidic. However, independent claims 1 and 24, as amended, recite cleaning or residue-removing compositions comprising hydroxylamine or a salt, phosphoric acid, and water. While initially it might seem like hydroxylammonium phosphate (chemical formula = $(H_3N^+OH)_3[(PO_4)^{-3}]$) is merely a reaction product of hydroxylamine and phosphoric acid, such is not necessarily the case. Indeed, the dissociation pKa of the three phosphoric acid protons are approximately 2.1, 7.2, and 12.7, respectively. Thus, in order to react phosphoric acid with hydroxylamine, or to separate phosphoric acid from

hydroxylammonium phosphate, the pH of that solution would have to be above about 12.7. While Leon teaches that its compositions can have a wide pH range (2-9), it also cautions against solutions that are too caustic (e.g., a pH of 12.7), noting that, at extreme pH values, “the metal layers on the substrate are subject to attack.” *See Id.*, column 5, lines 13-21. Therefore, Leon does not incidentally teach a composition comprising phosphoric acid. The Examiner has not disputed Applicants’ distinguishing of Leon from claims 1-13 and 17-28, and indeed noted that Applicants’ arguments were persuasive on page 2 of the Office Action.

Combination of References Does Not Teach the Claimed Invention

Finally, there are individual additional arguments that are pertinent to selected dependent claims. Even assuming, *arguendo*, that Gogg teaches the potential use of phosphoric acid in Leon’s cleaning composition, Applicants respectfully submit that Gogg still does not remedy the deficiencies of Leon with respect to certain claims.

With respect to claims 12 and 13, neither Leon nor Gogg teach or suggest including an organic solvent in their compositions. Indeed, Leon teaches against the use of organic solvents. See Leon at column 3, lines 60-65.

Claims 18, 29-31, and new claims 32-35, each recite the cleaner is substantially free of fluoride-containing compounds. The Examiner did not reject claims 29-31 over Leon and Gobbs, perhaps because of the recital of oxalic acid. Claim 18 should also be excused from this rejection, as Leon requires a fluorine-containing compound.

As Applicants can find no motivation for one of ordinary skill in the art to combine Leon and Gogg in such a way as to attain the invention recited in claims 1-13 and 17-28, as amended, Applicants respectfully submit that the rejection is based on improper hindsight and respectfully request its reconsideration and withdrawal.

2. Rejections Over Herdt.

Claims 1-5, 7-8, 14, and 29 stand rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 6,121,219 to Herdt *et al.* (“Herdt”), for the reasons set forth on page 4 of the Office Action. Applicants respectfully traverse.

Non-Analogous Art

Herdt is drawn to compositions and methods for cleaning organic beverage and food soils to remove carbohydrate and proteinaceous contaminants. *See, e.g.*, Herdt Abstract. Nowhere is

it disclosed, or even suggested, that the compositions of Herdt can be used to clean semiconductor substrates, as recited in instant independent claims 1 and 29, as amended.

Indeed, Applicants would have no reason to refer to the cleaners/residue removers of presently amended independent claims 1 and 29 as semiconductor cleaning/residue removing compositions were it not to distinguish them from any other composition of matter. Applicants' characterization is not, moreover, merely an expression of intended use, but more properly is a descriptive element of the compositions that breathes life into presently amended claims 1 and 29, as well as those claims depending therefrom. Such cleaners have a number of implicit limitations known to those of ordinary skill in the art, including such limitations such as the stringent metal ion concentration. Thus, Applicants respectfully submit that Herdt does not disclose or suggest all the elements of the rejected claims.

Further, as the art for cleaning organic beverage and food soils to remove carbohydrate and proteinaceous contaminants is clearly not analogous to the semiconductor substrate cleaning art, Applicants respectfully submit that one of ordinary skill in the art would have had no motivation to look to such non-analogous art nor any reasonable expectation of success in applying the compositions of Herdt to semiconductor substrates, in order to attain the invention recited in independent claims 1 and 29, as amended. Therefore, in light of the foregoing, Applicants respectfully submit that an obviousness rejection based on the Herdt disclosure cannot be maintained and has been overcome. Applicants respectfully request that the obviousness rejection thus be reconsidered and withdrawn.

The Cleaner of Herdt Does Not Meet All Limitations of Certain Claims

The concentrate formulations of Herdt are provided in Herdt in the Table at column 14, lines 40-49. To make the cleaner, the composition of Herdt is diluted with water to provide a 100 ppm to about 20,000 ppm formulation (0.01% to about 2% by weight). *See* Herdt at column 14, lines 50-52. Since the maximum useful concentration is diluted 50:1 with water to make a cleaning solution, the cleaning compositions of Herdt have up to 1.6% phosphoric acid, up to 0.8% organic acid, up to 0.8% solvent, up to 0.8% sequestrant, and up to 0.8% ether amine or quaternary ammonium compound, wherein the cleaner has at most 2% active ingredients.

With respect to claims 3-4, Herdt does not teach any hydroxylamine compounds. Hydroxylamine compounds have a formula $N(R_1, R_2, -OR_3)$, where each R is a hydrogen or an alkyl. None of the quaternary ammonium compounds of Herdt are hydroxylamine compounds.

With respect to claim 29, we note that claim 29 as amended (to remove the term about) now recites at least 0.5% of a tri or tetraalkylammonium salt and at least 1.5% phosphoric acid. While the disclosure of Herdts can in theory meet this, by making all other components such as the sequestrant, the organic acid, and the solvent each equal to ~0.002%, this is a stretch of the disclosure of Herdts that is clearly not within the teaching of Herdts.

3. Rejections Over Skee '370

Claims 1, 14-16, 24-25, and 30-31 stand rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 6,559,370 to Skee ("Skee '370"), for the reasons set forth on pages 4-5 of the Office Action. Applicants respectfully traverse.

Skee '370 discloses aqueous alkaline compositions for stripping or cleaning semiconductor wafers that contain one or more metal ion-free bases at sufficient amounts to produce a pH of about 10-13 and one or more bath stabilizing agents having at least one pKa in the range of 10-13 to maintain this pH, as well as many other optional components. *See Skee '370 Abstract and column 6, lines 25-37.*

Instant independent claims 1 and 24, as amended, for example, recite aqueous semiconductor cleaners/residue removers having a pH between about 2 and about 6, which is in contrast to the teachings of Skee '370, which require a pH of 10-13. Thus, Skee '370 does not disclose or suggest all the elements of independent claims 1 and 24, as well as any claims dependent therefrom.

Further, independent claim 25, as amended, recites an aqueous semiconductor cleaner/residue remover that consists essentially of phosphoric acid, a hydroxylamine or hydroxylamine derivative, and a fluoride-containing compound (and, as is obvious from the term "aqueous", and which was made explicit in this claim, water), such that no other components materially affecting the composition can be added. Applicants respectfully submit that addition of a surfactant, for example, would materially affect the composition. Skee '370, however, discloses the inclusion of surfactants at column 9, lines 17-25, as the Examiner noted on page 4 of the Office Action. At least for this reason, Applicants respectfully submit that Skee '370 teaches away from the invention recited in claim 25, and arguably does not disclose or suggest all the elements, or more particularly the absence thereof, of claim 25. To eliminate any argument that the phrase "consisting essentially of" language does not preclude the addition of

surfactants as taught by Skee '370, Applicants have amended claim 25 to explicitly recite that that the formulation is substantially free from surfactants.

Similarly to claim 25, claims 30 and 31 both recite aqueous semiconductor cleaners/residue removers that consists essentially of several recited components and that also contain substantially no organic solvents. Skee '370, however, discloses the inclusion of organic solvents at column 9, lines 1-15, as the Examiner noted on pages 4-5 of the Office Action. Whether due to the "consisting essentially of" language or to the "substantially no organic solvents" feature, Applicants respectfully submit that Skee '370 teaches away from the invention recited in claims 30 and 31, and arguably does not disclose or suggest all the elements, or more particularly the absence thereof, of claims 30 and 31.

As a result, Applicants respectfully submit that Skee '370 does not render obvious instant claims 1, 14-16, 24-25, and 30-31, as amended. Thus, for any or all of the foregoing reasons, Applicants respectfully submit that the obviousness rejection of claims 1, 14-16, 24-25, and 30-31, as amended, has been overcome and respectfully request that it be reconsidered and withdrawn.

4. Rejections Over Skee '403

Claims 30-31 stand rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 6,465,403 to Skee ("Skee '403"), for the reasons set forth on pages 5 of the Office Action. Applicants respectfully traverse.

Skee '403 discloses aqueous alkaline compositions for stripping or cleaning semiconductor wafers that contain one or more metal ion-free bases at sufficient amounts to produce a pH of about 10-13 and one or more bath stabilizing agents having at least one pKa in the range of 10-13 to maintain this pH, and also comprise a silicate (defined as a chelator), as well as many other optional components. *See Skee '403 Abstract and column 5, lines 35-40.*

Claim 30 recites an aqueous semiconductor cleaners/residue removers that consists essentially of water, at least 1.5% phosphoric acid, at least 0.3% if oxalic acid, and at least 0.3% of a monofunctional organic acid. While claim 30 allows for up to 1% of a chelator, it is obvious that the final composition will be acidic, and certainly can not have a pH near or above 10. As Skee '403 recites alkaline cleaners, Skee '403 does not disclose a composition which meets the limitation of claim 30.

Claim 31 recites a composition consisting essentially of phosphoric acid, oxalic acid, optionally a monofunctional organic acid, optionally ammonium hydroxide or a bi or tri-alkyl substituted ammonium hydroxide, and a chelator. Claim 1 was amended to recite the outer bounds of its allowable pH, that is, from about 1.5 and 9. Skee '403 requires a pH of 10 or greater. As a result, Applicants respectfully submit that Skee '403 does not render obvious instant claims 30-31.

Thus, for the foregoing reasons, Applicants respectfully submit that the obviousness rejection of claims 30-31 has been overcome and respectfully request that it be reconsidered and withdrawn.

4. Rejections Over Darmon

Claims 1 and 3 stand rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 5,262,285 to Darmon *et al.* ("Darmon"), for the reasons set forth on page 5 of the Office Action. Applicants respectfully traverse.

Darmon discloses a method for retouching a film image by applying a composition comprising water, 5-300g/l of sulfuric, hydrochloric, and/or phosphoric acids, and 1-100g/l of one or more primarily acidic compounds that includes hydroxylamine salts. *See, e.g.*, Darmon Abstract, and at column 2, lines 48-53. The particular hydroxylamine salt described in Darmon was hydroxylamine sulfate. It is known to one of ordinary skill in the art that hydroxylamine sulfate, and I suspect all other hydroxylamine salts, are acidic. As disclosed on every MSDS accompanying the sale of hydroxylamine sulfate, the pH of a 1% aqueous solution is about 3.6. Claim 1 recites an "alkaline compound". A salt of hydroxylamine is acidic. Therefore, Darmon does not disclose all the limitations of claim 1 or claim 3. Furthermore, independent claim 1, as amended recites that the aqueous semiconductor cleaning solution has a pH between about 1.5 and about 6, which is also neither disclosed nor suggested by Darmon. Thus, Applicants respectfully submit that Darmon does not disclose or suggest all the elements of the rejected claims.

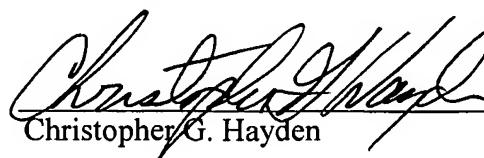
Additionally, Darmon discloses a method for retouching a film image by applying a composition comprising water, 5-300g/l of sulfuric, hydrochloric, and/or phosphoric acids, and 1-100g/l of one or more primarily acidic compounds that includes hydroxylamine salts. *See, e.g.*, Darmon Abstract, and at column 2, lines 48-53. Nowhere is it disclosed, or even suggested, that the compositions of Darmon can be used to clean semiconductor substrates, as recited in

instant claims 1 and 3, as amended. Indeed, Applicants would have no reason to refer to the cleaners/residue removers of presently amended claims 1 and 3 as semiconductor cleaning/residue removing compositions were it not to distinguish them from any other composition of matter. Applicants' characterization is not, moreover, merely an expression of intended use, but more properly is a descriptive element of the compositions that breathes life into presently amended claims 1 and 3. In addition, as the art for retouching film images is clearly not analogous to the semiconductor substrate cleaning art (among other things, the substrates are composed of very different materials), Applicants respectfully submit that one of ordinary skill in the art would have had no motivation to look to such non-analogous art nor any reasonable expectation of success in applying the compositions of Darmon to semiconductor substrates, in order to attain the invention recited in independent claims 1 and 3, as amended.

Therefore, in light of any or all of the foregoing, Applicants respectfully submit that an obviousness rejection based on the Darmon disclosure cannot be maintained and has been overcome. Applicants respectfully request that the obviousness rejection thus be reconsidered and withdrawn.

An Amendment Fee Sheet, with provision for the required fees associated with addition of no additional independent claims (two were added but two previously independent claims were converted to dependent claims) and 4 additional total claims, is enclosed herewith. Also enclosed herewith is a Petition for Extension of Time for one (1) additional month to respond to the pending Office Action, along with provision for the required fee. No other fees are believed to be due for this submission. Should any additional fees be required, however, please charge the required fee(s) to Morgan, Lewis & Bockius LLP Deposit Account No. 50-0310. A copy of this sheet is enclosed for such purpose.

Respectfully submitted,


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